Please use the following talking points to give an overview on SPICE operations. Please note that these points are targeted for two sets of audience- K-12 and college/technical community.

Thank you,

SPICE Talking Points for K-12:

Soot formation in hydrocarbon-fueled flames remains the most important unresolved problem of combustion science. Most of the properties people perceive in flames (e.g., visible size, color, temperature, spread rate) are controlled by the amount of soot present in the flame. Soot is the major source of radiated heat and light from flames and is a hazardous pollutant. Because of these properties, soot is a leading parameter in the durability and performance of power and propulsion systems, the hazards of unwanted fires, the pollutant emissions of combustors and the potential for developing computational combustion.

The origin of soot itself is surprising. Soot is formed from the gas phase in the fuel rich region (inside the flame near the bottom) of a flame and condenses into solid particles at high temperatures. At leaner regions (towards the top) of the flame soot begins to oxidize. This growth and oxidation process is very complex and is inextricably tied to the flame structure (flow, temperature and concentration fields). Given these complexities, a reliable indication of the propensity of a fuel to produce and emit soot requires a combustion test. For diffusion flames the most widely used test is the laminar smoke point.

Bullet type *points*

- Soot is a solid material that forms in the very high temperature zone of a flame from fragments of the fuel molecules
- It looks like a cluster of grapes where each grape is 400,000ths of a millimeter in size, hundreds of these group together to make clusters that are 1000 to 10,000th of a millimeter in size
- It is amazing that at the high temperatures in a flame > 2000 degrees F, a solid material will solidify from the gaseous fuel
- Because soot is a solid it can glow like a solid and become “red to white hot” That is what makes flames bright.
- This light also carries heat
- A soot free flame will be pale blue like a gas stove flame
- Without soot you could not read by candle light
- Without soot you could not warm yourself by a campfire
- Soot is an important pollutant that has negative health effects world wide
- Soot is very important and you want to have it in some flames but not in others. On your stove you heat the pots with the warm air (so you don’t want soot because it makes the pots dirty) but in your camp fire the radiant heat is what warms you (so you want soot)

- The smoke point is the largest possible flame before it emits soot- that is what you do when you adjust the wick on an oil lamp to maximize the light without smoke
- Soot is the major component of diesel truck smoke and is not good to inhale large amounts because the particles are so small
- You can see the effect of soot by briefly putting a cold knife blade into a candle flame. At the bottom there is no soot. In the middle you will get a ring of soot (the flame is hollow) and at the top you will get a circle. Above the flame you will only get water condensing.
- Modern candles are designed to keep the flame below the smoke point by causing the wick to curl. 200 years ago people had to trim the wicks of their candles every 20 minutes to keep the flame bright and to prevent the buildup of too much soot in the room.

Talking Points for college/technical audience:

Overview:
The Smoke Point In Co-flow Experiment (SPICE) determines the point at which gas-jet flames (similar to a butane-lighter flame) begin to emit soot (dark carbonaceous particulate formed inside the flame) in microgravity. Studying a soot emitting flame is important in understanding the ability of fires to spread and in control of soot in practical combustion systems space. This experiment will be performed within the Microgravity Science Glovebox.

Talking points:

- The SPICE experiment will lead to an
    - improved design of practical combustors through improved control of soot formation;
    - improved understanding of and ability to predict heat release, soot production and emission in microgravity fires; and,
    - improved flammability criteria for selection of materials for use in the next generation of spacecraft.

- Previous experiments show that soot dominates the heat emitted from flames in normal gravity and microgravity fires.
    - Control of this heat emission is critical for prevention of the spread of fires on Earth and in space for the design of efficient combustion systems (jet engines and power generation boilers).

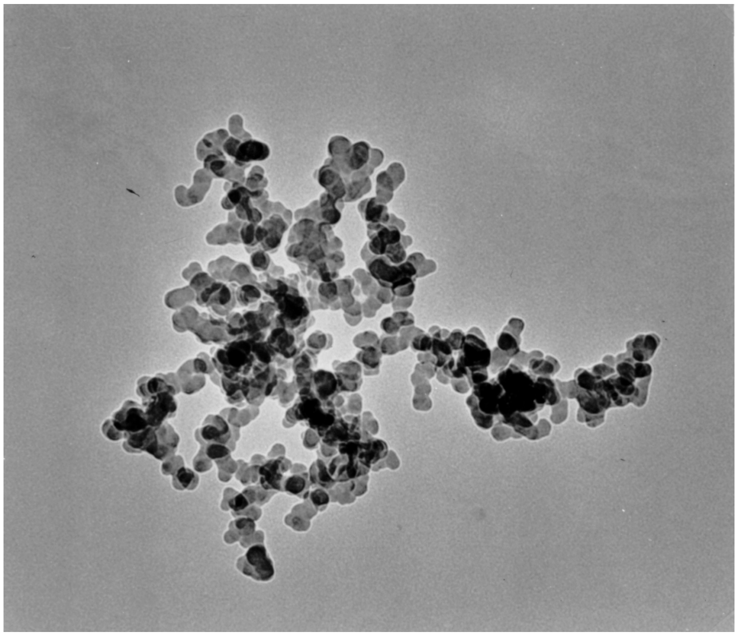
- The onset of soot emission from small gas jet flames (similar to a butane-lighter flame) will be studied to provide a database that can be used to assess the interaction between fuel chemistry and flow conditions on soot formation.
    - SPICE will stabilize an enclosed laminar flame in a co-flowing oxidizer, measure the overall **flame shape** to validate the theoretical and numerical predictions, measure the **flame stabilization heights**, and measure the **temperature field** to verify flame structure predictions.
    - These results will be used to support combustion theories and to assess fire behavior in microgravity.

- **Space Applications:**
    - Current NASA spacecraft materials selection is based upon a simplified test method that segregates material based upon behavior on Earth without real consideration of microgravity effects. A critical element of this understanding is the radiative heat emission from the flame. This heat emission is strongly influenced by the extent of soot formation. Improved understanding of soot formation and thereby the heat release from microgravity fires will allow more complete and effective utilization of the flammability test results. These results can be used in first-order models and predictions of heat release in spacecraft fires and as a means to extend heat release data from tests like the NASA cone-calorimeter test to microgravity fires to a performance based material selection process.

- **Earth Applications:**
    - The smoke-point phenomena is a classical metric in the understanding of the heat release and spread rate of fires. It is commonly used in fire modeling on Earth and to understand the soot growth and emission by flames. The dominant characteristics of many flames of practical interest are nonbuoyant. SPICE seeks to extend our understanding by looking at the interaction of ambient flow with the smoke point, enabling us to better predict heat release from non-buoyant flames in practical combustors (e.g. jet engines and furnaces).

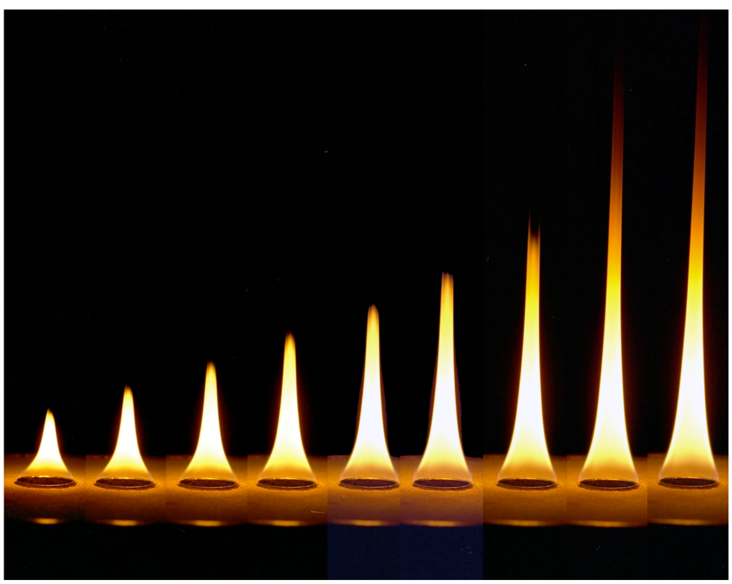
- **International Components:**
    - The Microgravity Science Glovebox (MSG) was developed by ESA (Noordwijk, The Netherlands), and the SPICE experiment is sponsored by NASA.
        - The MSG is currently located within the ESA-owned Columbus module.

-Following pictures are provided only for added interest:

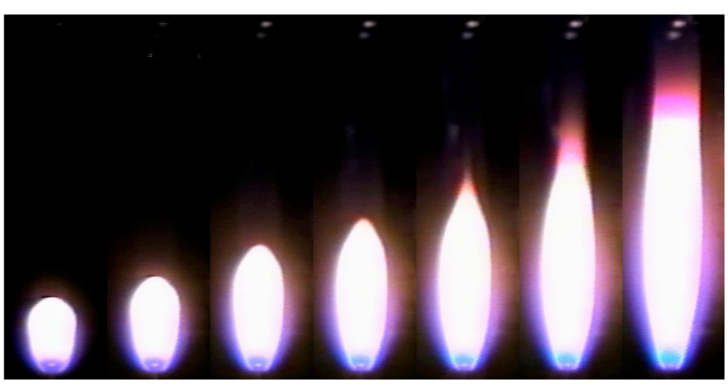


Transmission electron micrograph of a soot particle captures on STS-83. Small particles are about 40 nm in diameter

Early Jet aircraft combustors (left) produced substantial soot emissions at high thrust. The simple spray combustors had combustion characteristics similar to diesel combustors. Combustor designs of new jet aircraft (right) have much less evident soot emissions, achieved by improved performance, increased dilution and air atomization.



Onset of smoke point in 1-g



Onset of smoke point in low-g (STS-83)